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(54) Laser apparatus

(57) Laser apparatus includes a laser and optical means 13 for directing an output beam 22 of the laser through a first nozzle 20 onto a workpiece 14. The nozzle has an aperture through which the laser output beam and a first stream of gas may pass. A second nozzle 24 is provided, coaxial with and surrounding the first nozzle and having an aperture 25 through which a second stream of gas may pass. Gas control means are provided to determine the rate of flow and nature of the gas flowing through each nozzle.

Fig. 2.

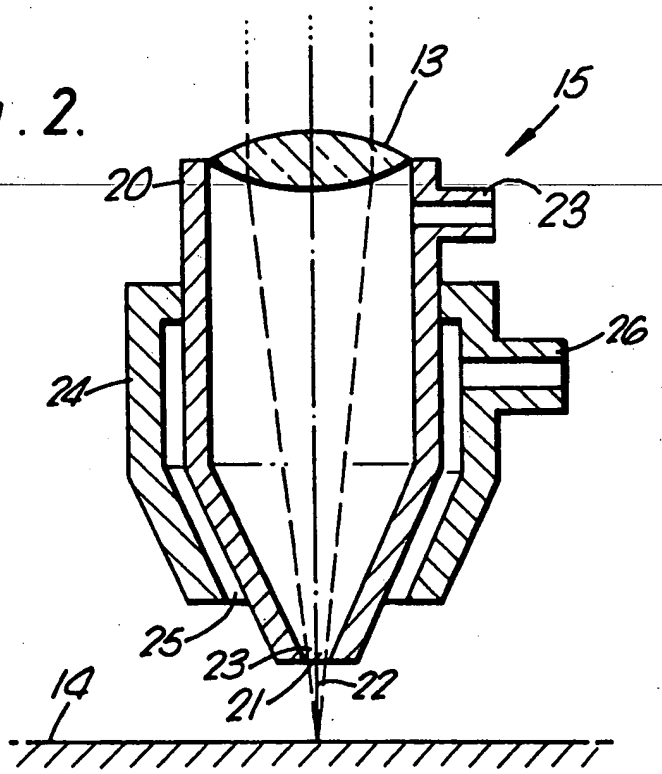

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Fig .1.

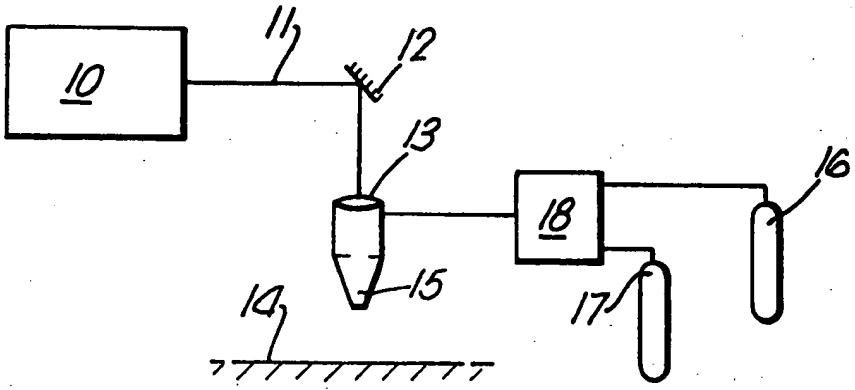


Fig . 2.

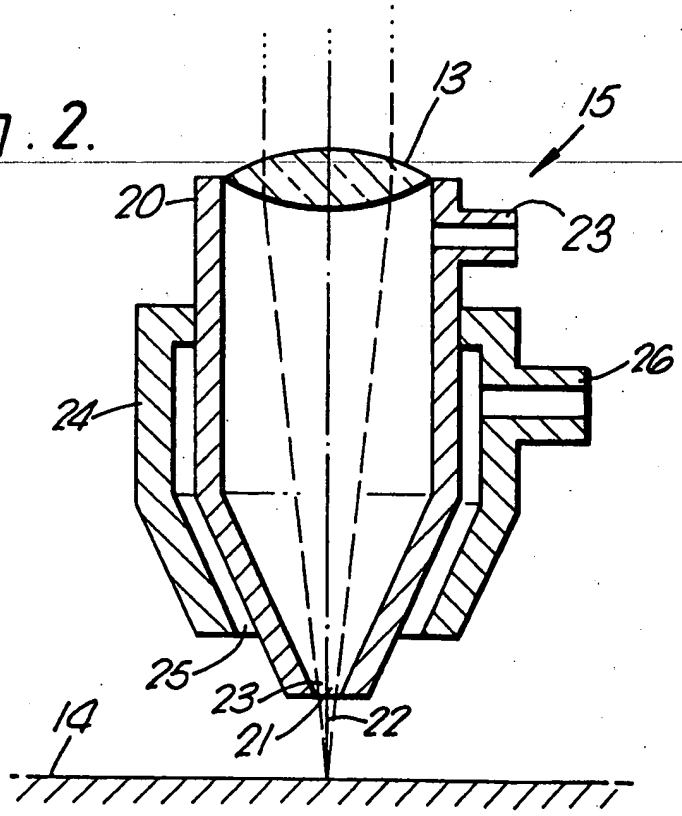
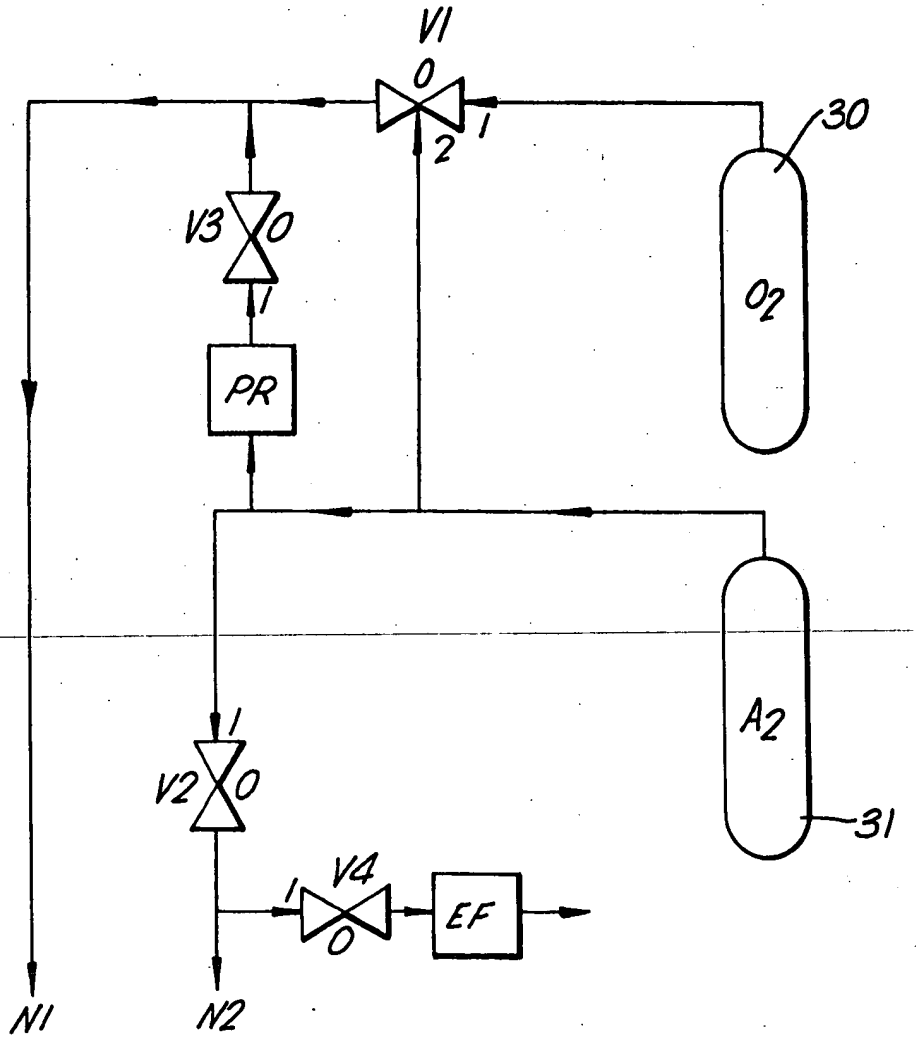


Fig . 3.



SPECIFICATION

Laser apparatus

This invention relates to laser apparatus and in particular to such apparatus which includes a gas nozzle through which the laser beam and a flow of gas may be directed on to a workpiece.

Gas-jet lasers, as they are commonly called, are used in particular for cutting a wide range of materials. For such an application a nozzle of relatively small diameter is used, typically of the order of 1.5mm. In addition the gas flow has to be at such a rate that the gas will blow away molten or vapourised material from the working area. The nature of the gas is dependent upon the material being cut. The cutting of metals frequently requires a gas such as oxygen which will promote an exothermic reaction, whilst combustible materials such as wood or paper require a gas which does not support combustion.

Another common use for gas-jet lasers is in welding. In this application the material is melted in the working area, but must not be removed. Hence the gas velocity must be low. The gas is essential, however, to provide a shield around the working area, and must be an inert gas to prevent any unwanted chemical reactions from taking place. These two requirements are satisfied by a nozzle of relatively large diameter, say of the order of 8 to 10mm. If a nozzle suitable for welding is used for cutting either or both of two problems arise. With normal gas flow from a large nozzle the gas pressure will be insufficient to blow away the molten material, and may also allow debris to reach the lens carried in the nozzle for focussing the laser beam. Alternatively, if the gas pressure is sufficient for the purposed, the required gas flow rate will be very large.

If, on the other hand, a nozzle suitable for cutting is used for welding there will not be enough gas around the working area to form an adequate shield. In addition, even a relatively low flow rate through a small nozzle may blow molten metal away from the working area.

It will be clear, therefore, that it is necessary to change the gas nozzle when changing between welding and cutting operation. Accordingly it is an object of the present invention to provide laser apparatus in which changing of the gas nozzle is unnecessary.

According to the present invention there is provided laser apparatus which includes a laser, optical means for directing an output beam of the laser through a first nozzle on to a workpiece, the nozzle having an aperture through which the laser output beam and a first stream of gas may pass, a second nozzle coaxial with and surrounding the first nozzle, stream of gas may pass, and gas control means operable to determine the rate of flow and nature of the gas flowing through each of the two coaxial nozzles.

The invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a schematic diagram of laser apparatus according to the invention;

Figure 2 shows a sectional view of the gas nozzle arrangement of Fig. 1; and

Figure 3 illustrates one form of gas control means.

Referring now to Fig. 1, this shows a laser 10, preferably a CO_2 laser, which produces an output beam 11. The output beam is directed by means of a mirror 12 and a lens 13 onto the surface of a workpiece 14. The lens 13 is located in or adjacent to a gas nozzle 15 through which the laser output beam passes, and the lens operates to focus the laser beam on to the surface of the workpiece 14. The flow of gas through the nozzle 15 from either or both of two gas cylinders 16 and 17 is controlled by gas control means shown schematically at 18. The apparatus will have some means (not shown) for moving the nozzle and the workpiece relative to one another.

Fig. 2 shows the nozzle 15 in greater detail. The first or inner nozzle 20 has the lens 13 located at one end forming both a window for the laser beam and a pressure seal for the gas. The nozzle tapers down to an aperture 21 which permits the passage of the laser beam, shown in dotted outline at 22 focussed on to the workpiece 14. A gas inlet 23 allows gas from a supply to flow into the nozzle 20 and out through the aperture 21. This aperture is of the diameter necessary for laser cutting operations, say 1.5mm as suggested earlier.

A second nozzle 24 surrounds the first nozzle 20 and has a second aperture 25 coaxial with and surrounding the first aperture 22. The second nozzle 24 has a gas inlet 26. The diameter of the second aperture 25 will be that required for welding operations, say 8 to 10mm as suggested earlier. The inner nozzle may extend closer to the workpiece 14 than does the outer nozzle, as shown in Fig. 2.

When used for cutting operations a supply of gas at a relatively high flow rate is applied to the inner nozzle 22 from the gas supply. This gas may be inert or not depending upon the material to be cut. No gas flow is necessary from the second nozzle. Though it would be possible to apply suction to this nozzle for fume extraction purposes.

When welding, a supply of inert gas at a relatively high flow rate is applied to the outer nozzle to provide the necessary gas shield. Though it is not necessary for gas to flow through the inner nozzle, this may be advisable to prevent the deposition of material on

must be an inert gas at a relatively low pressure.

Fig. 3 illustrates one form of gas control means which will satisfy the requirements set out above. The gases required, usually oxygen and argon, are supported from high-pressure cylinders 30 and 31 respectively. A three-way gas valve VI is connected to both gas supplies and to the inner nozzle. In position 1 the valve VI supplies high-pressure oxygen to the inner nozzle NI whilst in position 2 it supplies high-pressure argon to the inner nozzle. In position 0 the valve VI is closed. The high-pressure argon supply is also connected to the outer nozzle N2 by way of an on/off valve V2.

A pressure reducer RP and an on/off valve V3 connect the high-pressure argon supply to the inner nozzle N1 to a low-pressure argon flow to that nozzle when required. Finally, a valve V4 connects an extractor fan or pump EF to the outer nozzle N2 for fume extraction purposes.

When cutting, valve V1 requires to be in position 1 or position 2 to supply high-pressure gas to the inner nozzle. Valves V2 and V3 will be closed, whilst valve V4 may be in either the open or closed position depending upon whether or not fume extraction is required.

When welding, valve V2 will be open to supply high-pressure argon to the outer nozzle, and valves V1 and V4 will be closed. Valve V3 will be open only if low pressure argon is to be supported to the inner nozzle.

The valve arrangement shown in Fig. 3 may be modified to achieve the same results. Equally, the composition of the gases used may be changed, and it is possible to apply two different inert gases to the inner and outer nozzles when welding. Nitrogen is one example of an alternative inert gas suitable for use when welding with a laser.

The valves of the gas control means shown in Fig. 3 may be remotely operated by a suitable control circuit or may be manually-operated valves.

CLAIMS

1. Laser apparatus which includes a laser optical means for directing an output beam of the laser through a first nozzle on to a workpiece, the nozzle having an Aperture through which the laser output beam and a first stream of gas may pass, a second nozzle coaxial with and surrounding the first nozzle, and having an aperture through which a second stream of gas may pass, and gas control means operable to determine the rate of flow and nature of the gas flowing through each of the two coaxial nozzles.

2. Apparatus as claimed in Claim 1 in which the aperture of the first nozzle has a diameter suitable for performing a cutting operation on the workpiece.

3. Apparatus as claimed in Claim 2 in which the diameter of the aperture of the first nozzle is of the order of 1.5mm.

4. Apparatus as claimed in any one of Claims 1 to 3 in which the aperture of the second nozzle has a diameter suitable for performing a welding operation on the workpiece.

5. Apparatus as claimed in Claim 4 in which the diameter of the aperture in the second nozzle is of the order of 8 to 10mm.

6. Apparatus as claimed in any one of the preceding claims in which the first nozzle extends closer to the workpiece than does the second nozzle.

7. Apparatus as claimed in any one of Claim 1 to 6 in which the gas control means is operable to apply a gas at a relatively high pressure to the first nozzle.

8. Apparatus as claimed in Claim 7 in which the gas is one which promotes an exothermic reaction at the workpiece.

9. Apparatus as claimed in Claim 8 in which the gas is oxygen.

10. Apparatus As claimed in Claim 7 in which the gas is an inert gas.

11. Apparatus as claimed in Claim 10 in which the gas is one of the group containing argon and nitrogen.

12. Apparatus as claimed in any one of the Claims 7 to 11 in which suction is applied to the second nozzle.

13. Apparatus as claimed in any one of Claims 1 to 6 in which the gas control means is operable to apply an inert gas at a relatively high pressure to the second nozzle.

14. Apparatus as claimed in Claim 13 in which the gas control means is also operable to apply an inert gas at a relatively low pressure to the first nozzle.

15. Apparatus as claimed in either of Claims 13 or 14 in which the inert gas is one of the group containing argon and nitrogen.

16. Laser apparatus substantially as herein described with reference to the accompanying drawings.

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